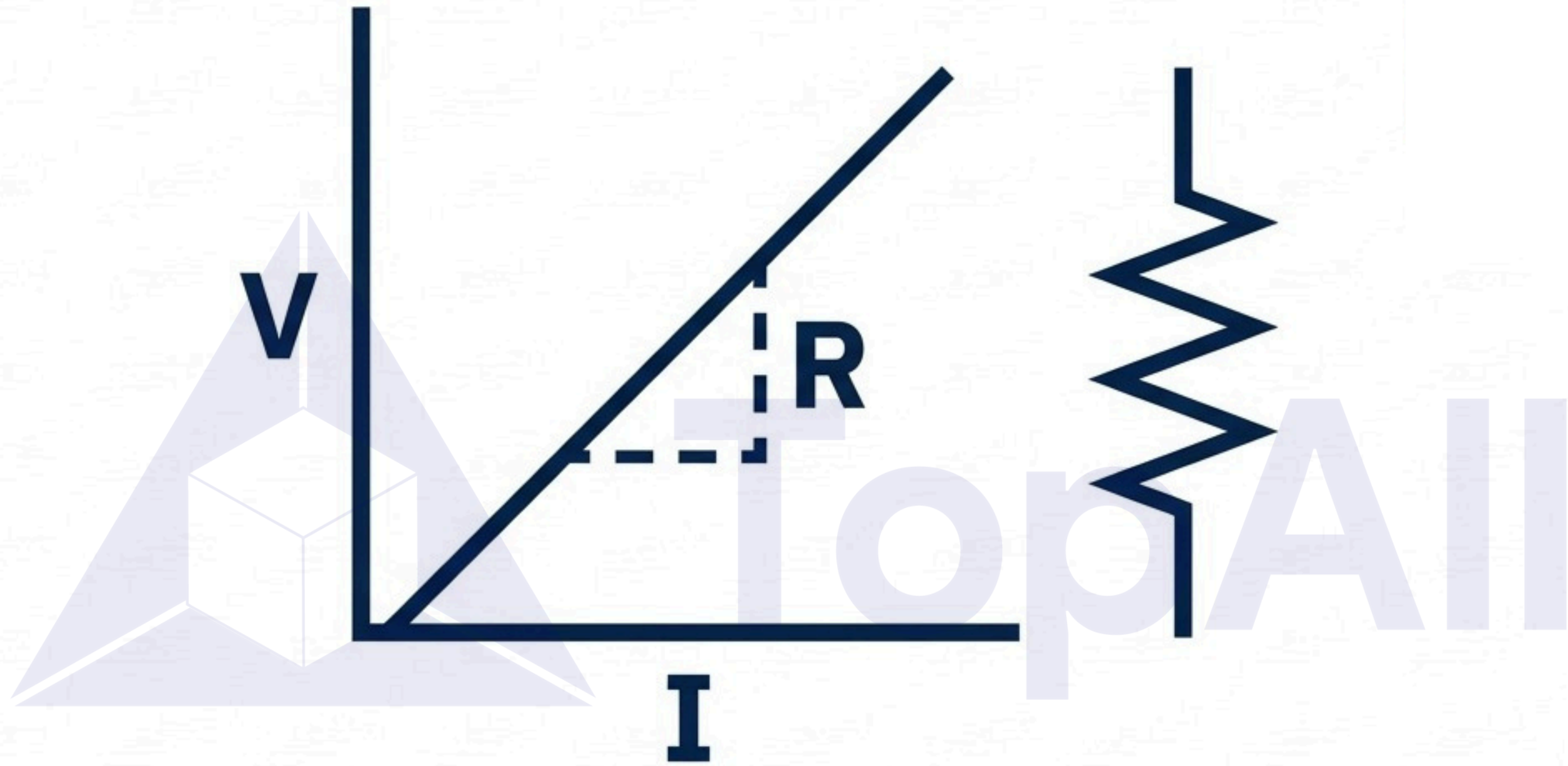




Ohm's Law, Resistance and Resistivity

Macroscopic laws to microscopic properties.

The Macroscopic Observation



$$V \propto I$$

V: Potential difference
across conductor (Volts)

I: Steady current
flowing (Amperes)

$$V = RI$$

R: Resistance, the constant of proportionality (Ω)

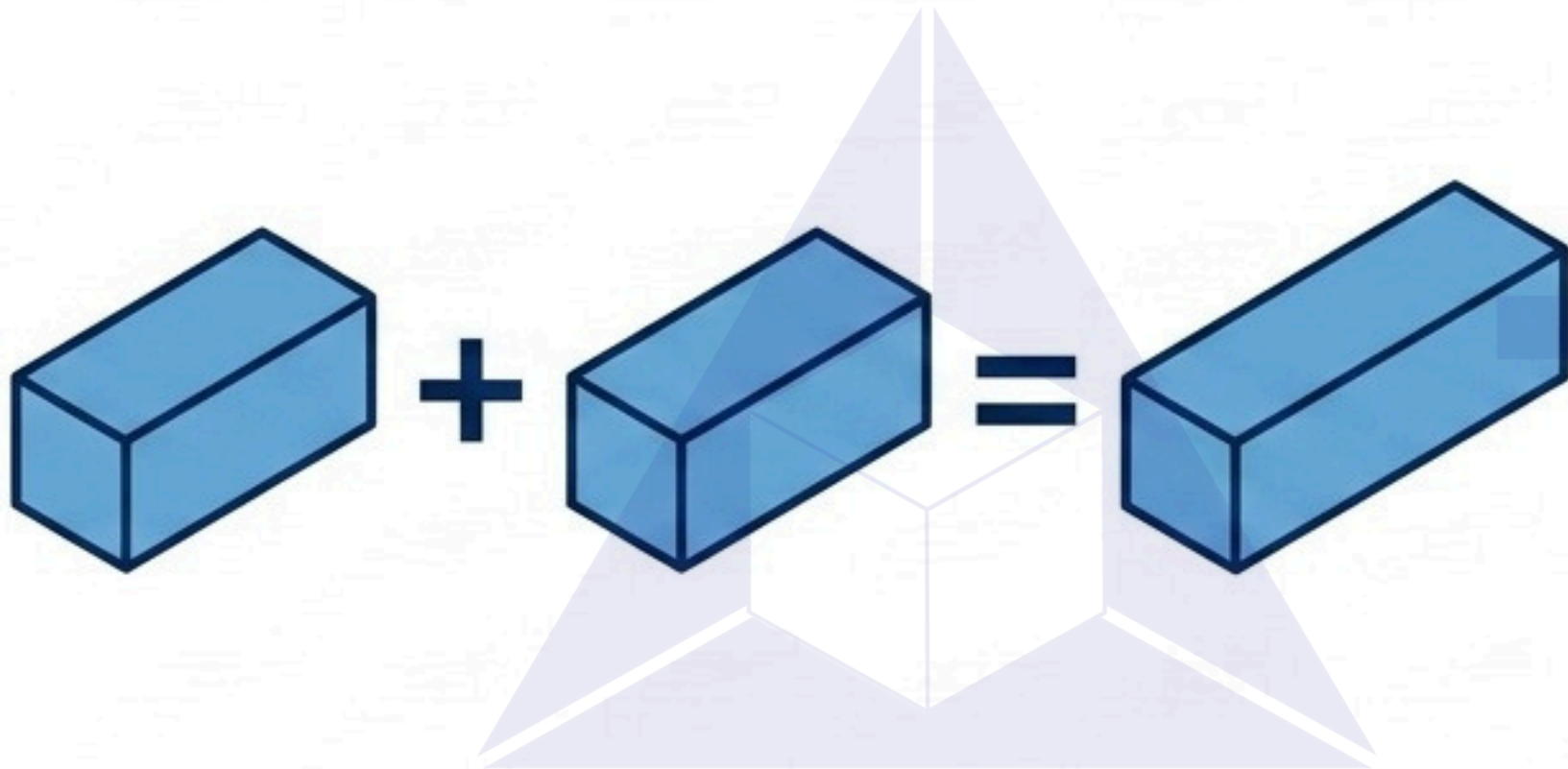
Ohm's Law is NOT a universal law of nature—it is a material property observed under constant physical conditions.

The Geometric Dependence of Resistance

Derivation Insight

A

Series / Length

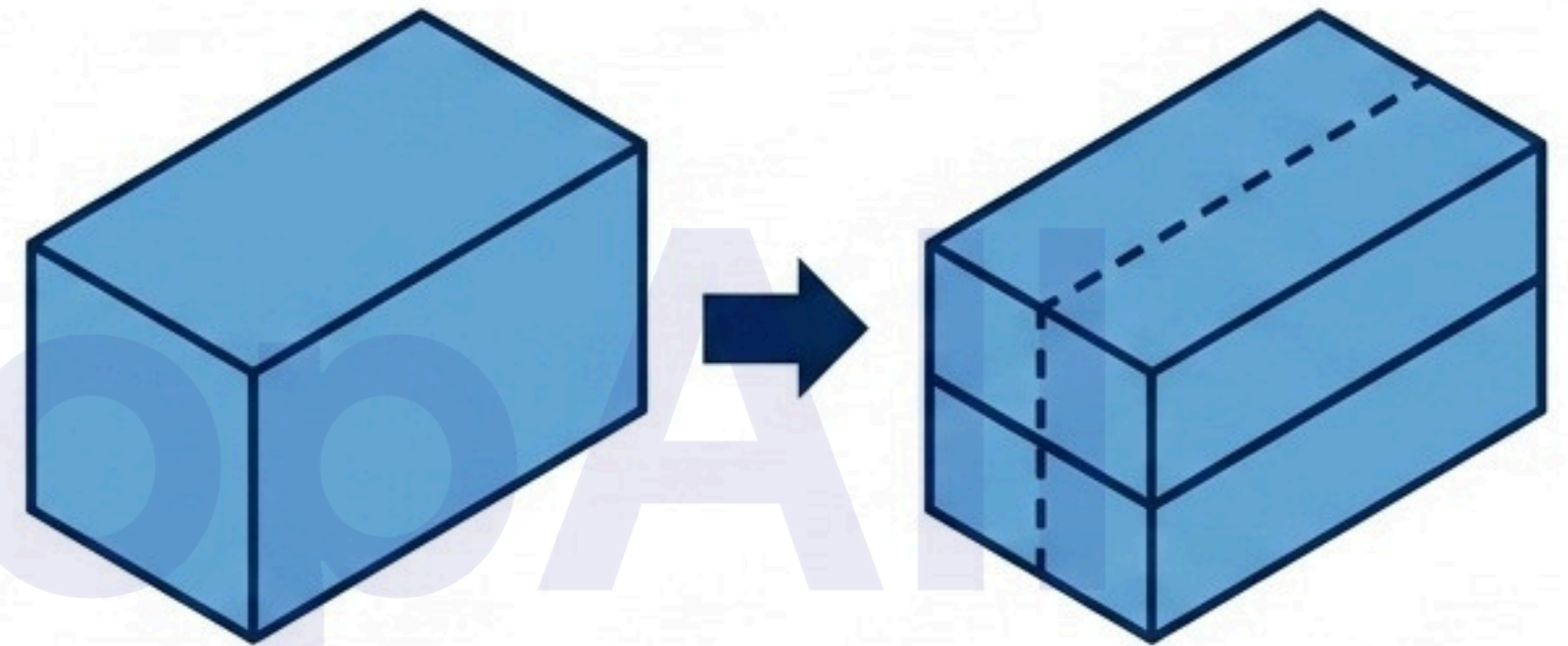


$$V + V = 2V \rightarrow 2V/I = 2R$$

$$R \propto l$$

B

Parallel / Area



$$\text{Current } I \text{ splits into } I/2 \rightarrow V/(I/2) = 2R$$

$$R \propto 1/A$$



You've Learned the Theory. Let's Test Them Now.

$$E=mc^2$$



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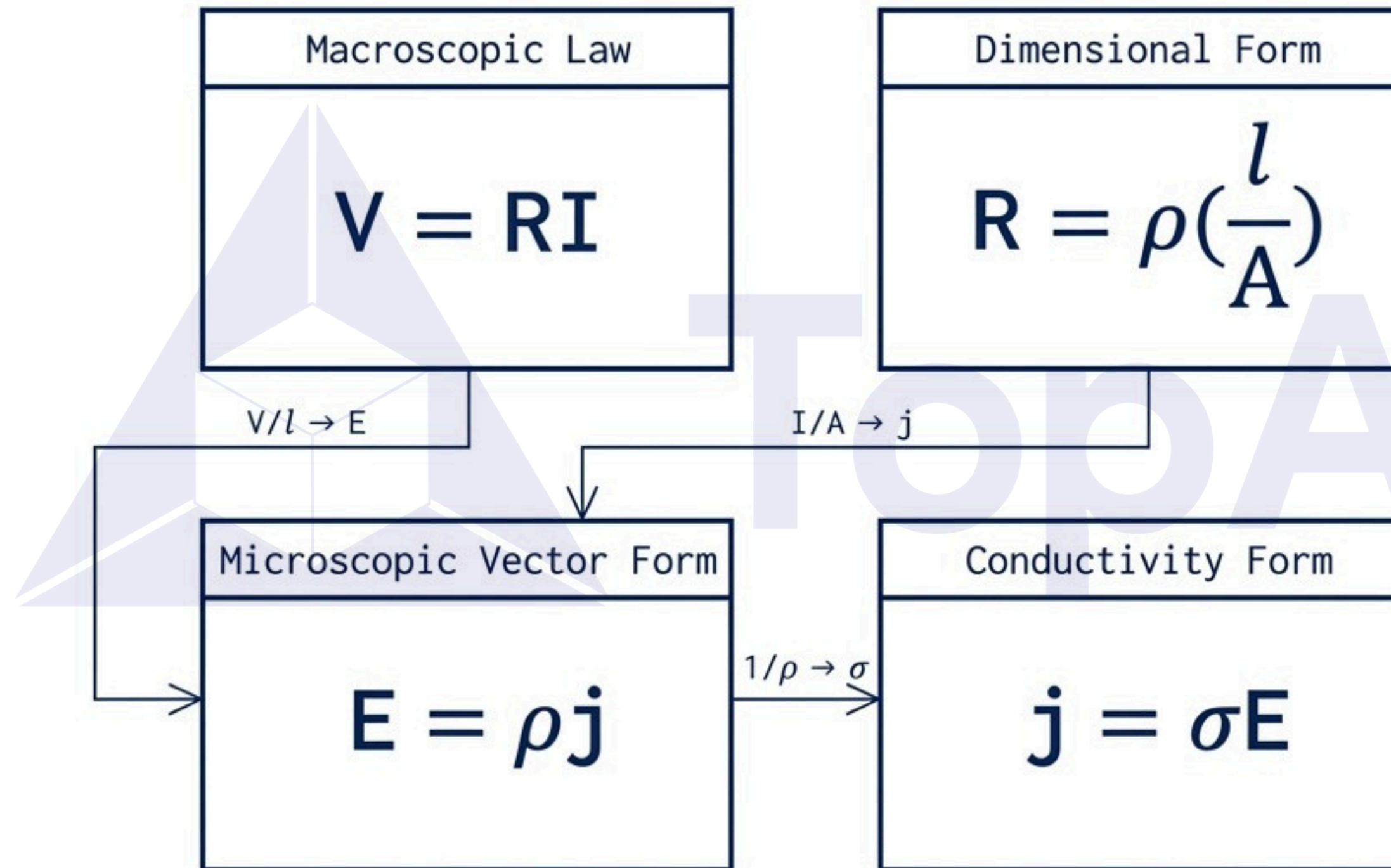
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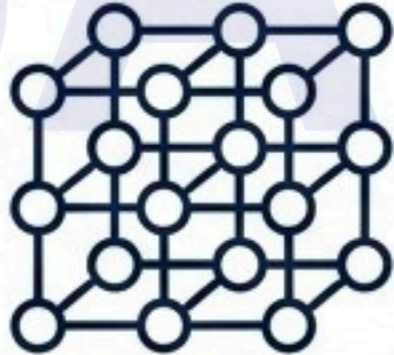


The Formula Bank: Macro to Micro



Diagnostic: Resistance vs. Resistivity

TRAP: Assuming Resistivity Changes with Shape or Dimensions.

Resistance (R)	Resistivity (ρ)
	
- Property of the specific object. - Changes if you stretch, cut, or bend it.	- Property of the material itself. - ONLY changes with temperature or material impurities. - Dimensions (l, A) do not affect it.

Mini Application: The “Stretched Wire” Problem

Problem: If you stretch a wire to double its length ($2l$), what happens to its resistance?



Volume remains constant.

$$A_1 l_1 = A_2 l_2$$



If length doubles ($2l$),
Area must halve ($A/2$).



The Math Resolution:

$$R_{\text{new}} = \rho(2l) / (A/2) = 4\rho(l/A) = 4R$$

TRAP: Don't forget the area halves!
Assuming $R_{\text{new}} = 2R$ is the most common error.

Chapter Revision Snapshot

Ready for
Practice

$$R \propto l$$

$$R \propto \frac{1}{A}$$

$\rho = \text{constant}$
for a given
material/temp



Mastering the geometric dependence of $R = \rho(l/A)$ combined with constant volume logic will solve 90% of basic circuit resistance problems in the JEE.



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